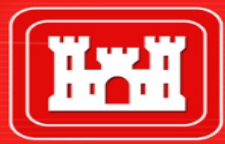




Multi-Purpose Projects

Module M3: Trade – off Analysis
for Comparison and Selection



Student Learning Objectives

The Student will be able to:

- Identify “trade-off” situations
- Identify how trade-off methods are useful in reformulation
- Describe valid approaches for comparing multiple outputs across plans



Trade-Off Situation

- Faster
- Better
- Safer
- Cheaper
- Greener

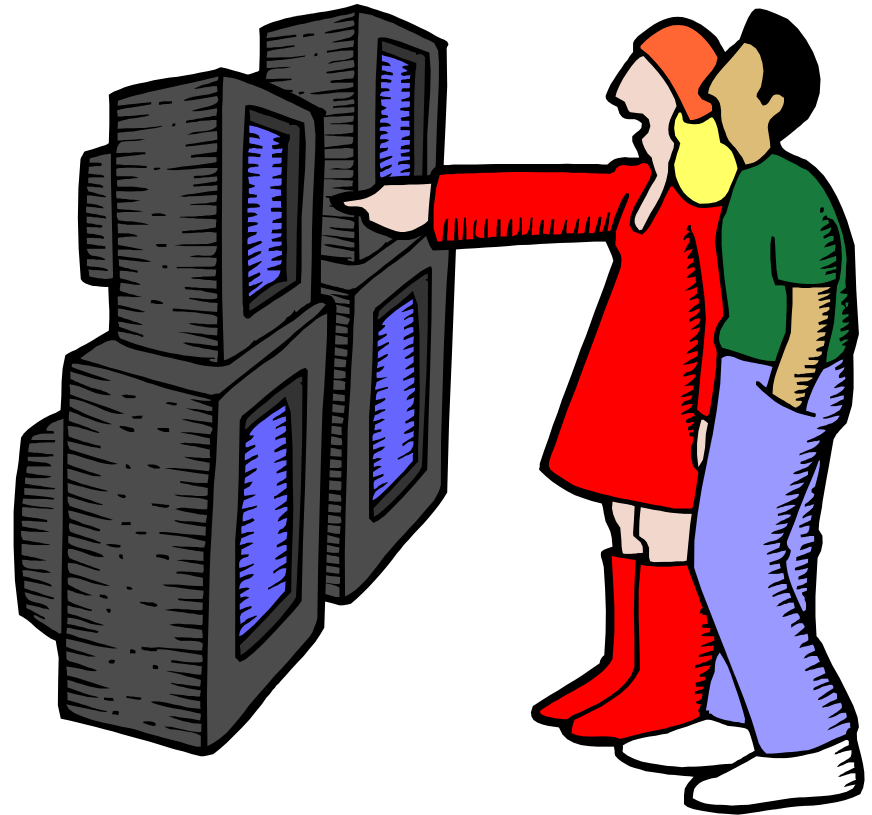
(Can't have all three)

A Process for Comparison of Plans

- Identify trade off situations
- Choose KEY criteria
 - Federal policy
 - Local sponsor policy
 - Stakeholder interests
 - Outputs
- Choose a technique
- Inform Decision Makers of possible choices

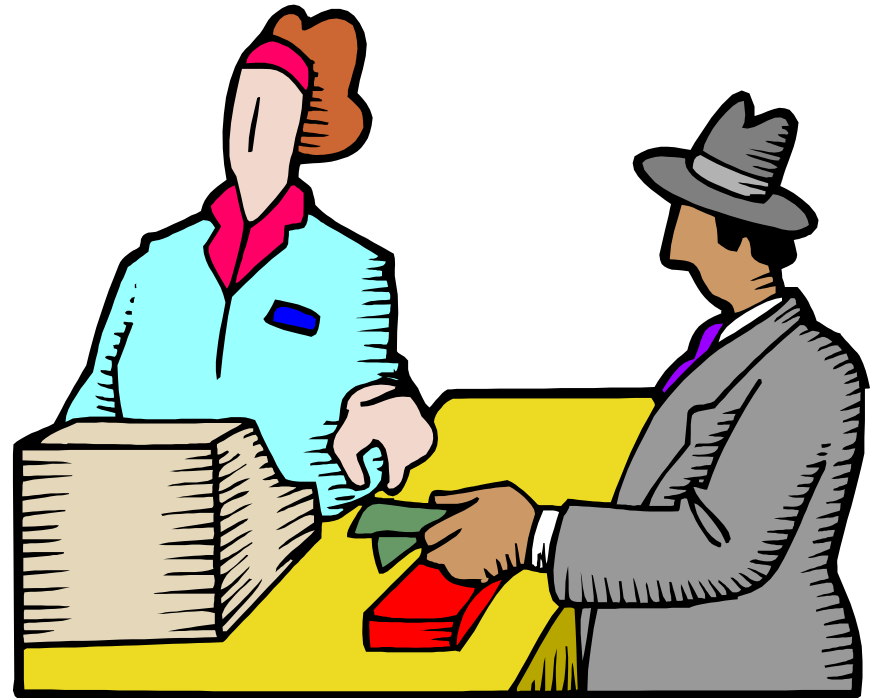
Trade-Off Situation

- Opportunity cost concept - Where you have to give up something to get something else
- Can't have both



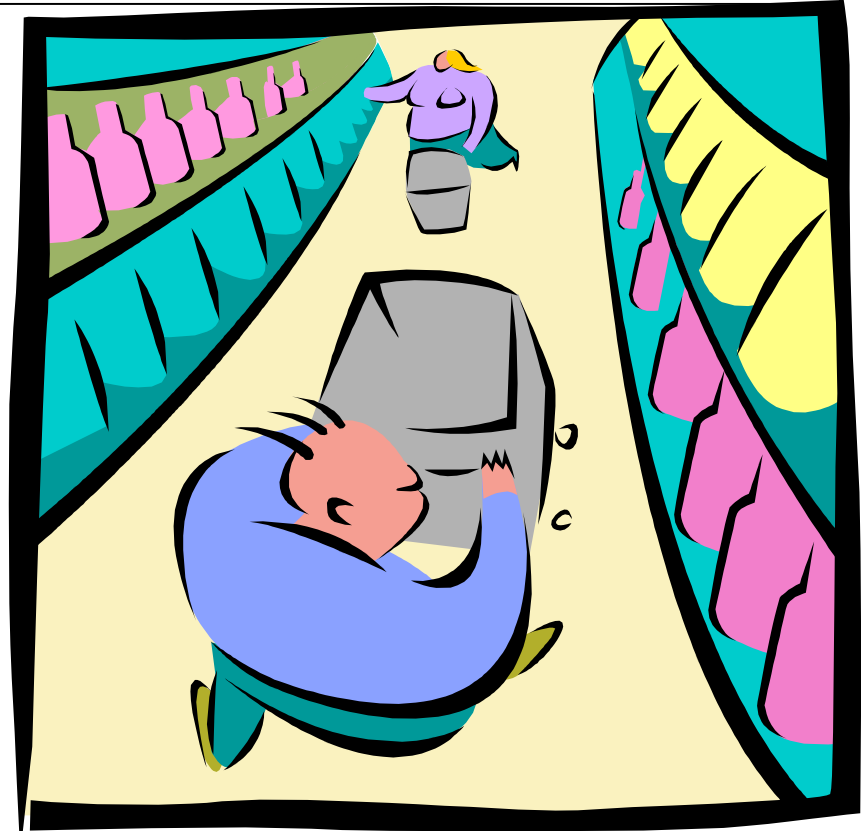
Making Trade-Offs

- **One case: dollars only**
- **Another case: NER is involved**
- **Professional judgments are inherent in complex trade off situations**
- **Team should NOT decide on the best plan without public input**

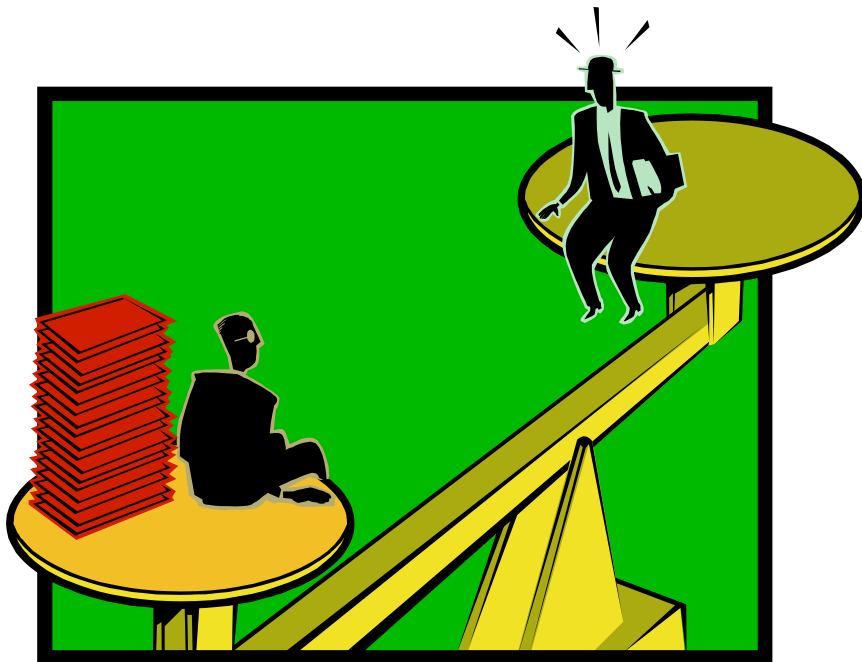


Choosing Key Criteria

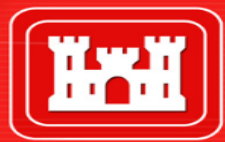
- **Consider planning objectives and constraints**
- **Federal rules**
- **Opinions of stakeholders**
- **Resource Agencies comments**
- **Sometimes all plans have comparable impacts on most key variables**
- **Emphasize impacts where the plans actually make a difference; the impacts are NOT the same for every plan**



Some Trade-Off Techniques



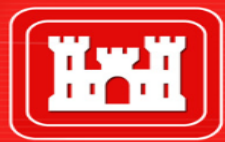
- Simple ranking index
- Weighted ranking
- Professional judgment
- Effects Matrix
- Dominance
- Threshold



Caveat

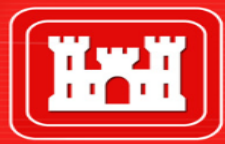
There is no way to objectively conclude that one plan is better than another, especially where non-monetary trade-offs are involved.

Therefore, the purpose of multicriteria trade-off methods is to improve the quality of decisions by making the decision making process more explicit, rational, and efficient.



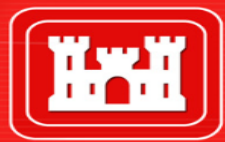
Trade-offs: A Simple Example

- The blue car has bucket seats
- The green car does not
- Your favorite color is green, and you prefer bucket seats
- A green car with bucket seats is not one of your options, and you will buy a car
- How to decide?



Choosing a Car

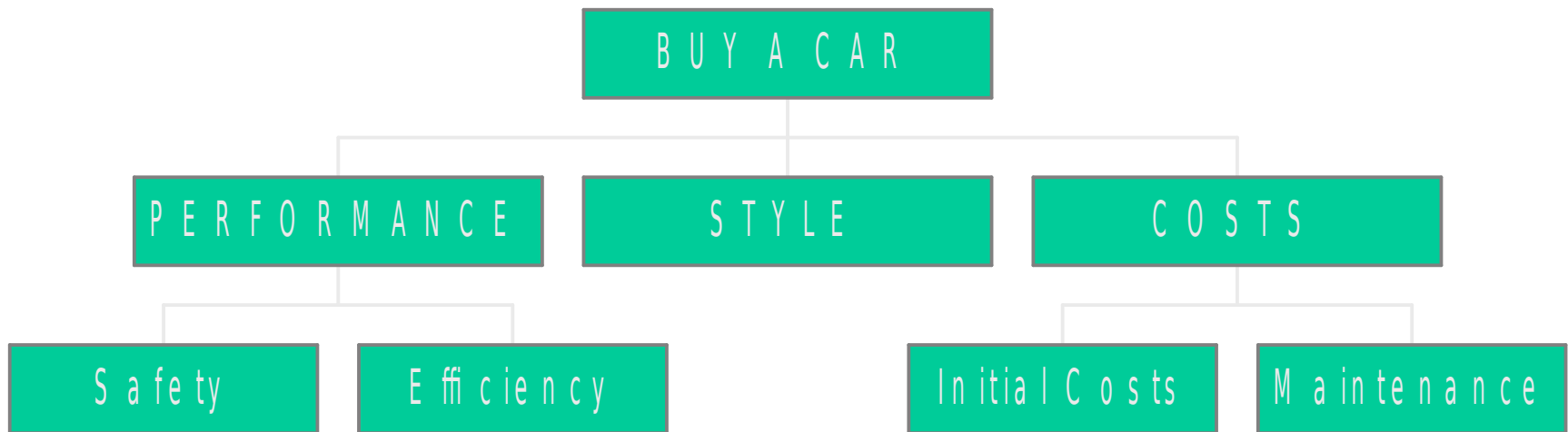
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- Key variables
 - Measurement within variables
 - Comparison across variables

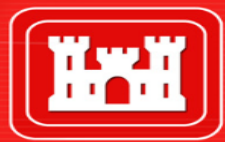


Choosing a Car: Potential Trade-off Variables

- Safety
- Durability
- Resale value
- Size
- Fuel efficiency
- Maintenance costs
- Aesthetics
- “Buy America”
- Sound system
- Sunroof
- Security system
- Price

Choosing a Car: Organizing the Decision





Choosing a Car: Choice Will Differ Based on Perspective

- Buying for yourself
 - Buying for your family
 - Someone buying for you as a gift
 - Buying for a rental car firm
 - Buying for GSA
-
- Analogous to different perspectives of various partners in Corps trade-off situations



Trade-Offs Defined

Trade-offs—giving up one thing to gain another;
competing and mutually exclusive trade-offs

- Explicit—terms of trade fixed by laws of universe
- Implicit—terms of trade fixed by the value systems and preferences of decision makers
- Value trade-offs—divergent and incommensurable values



Multi-Criteria Decision Making

- Offers a sometimes-unwelcome objectivity
 - Reveals the extent to which our decisions are arbitrary and based on intuition or politics
- Distinguishes that which we know objectively from that which we do not know
- Provides us with the opportunity to address conflicts by identifying them
- Does not produce decisions, nor resolve conflicts
- Corps' planning process ideally suited to trade-off



Multicriteria Models

- Plethora of models available
- No one of them is best



Decision Support System

- Relevant for planning because investigations tend to have multiple problems
 - Multi-dimensional, complex
 - Conflicting objectives, value systems
- Aggregating or optimizing a single objective cannot produce solutions to such problems
- Solutions involve multiple criteria, trade-offs, compromise, conflict resolution and judgment



Alternatives

- Ultimate planning choice problem--Select the best alternative from among a set of alternatives
- Multiple approaches & techniques
 - Sorting – qualified or not qualified
 - Ranking – best to worst
 - Choice – identify “best” based on criteria
- Plan formulation process is a critical part of the multicriteria analysis

Criteria

- A test, principle, rule, canon, or standard, by which anything is judged or estimated
- Criteria are used in multicriteria analysis to judge the alternative solutions to the decision problem
- Criteria are used in the planning process to select the recommended plan
- Criteria used in MCDM are likely to be a subset of the more numerous criteria used for more and broader purposes in the planning process

Decision Matrix

- Summarizes the performance of each alternative for each criterion
- Similar to planners' system of accounts
- Information in the decision matrix forms the basis for either the recommendation to the decision maker or the decision maker's selection of the recommended plan

Decision Matrix: Construction and use

- Alternatives in rows and criteria in columns
- Pre-analysis of the matrix
- Normalization of the pre-analyzed decision matrix
- Distinguished by the facts
 - It includes only those criteria and all those criteria upon which the decision will be based
 - Consists only of alternative plans from which the recommended plan will be picked

Construction of Decision Matrix

	Net NED Benefits	First Cost	Aquatic Habitat	Upland Habitat
Plan 1	\$477,000	\$15,663,000	Slight decrease	+45HUs
Plan 2	\$196,000	\$19,610,000	Modest increase	+40HUs
Plan 3	\$260,000	\$13,450,000	No change	+30HUs
Plan 4	\$294,000	\$17,403,000	Slight increase	+60HUs

Pre-Analysis of Matrix

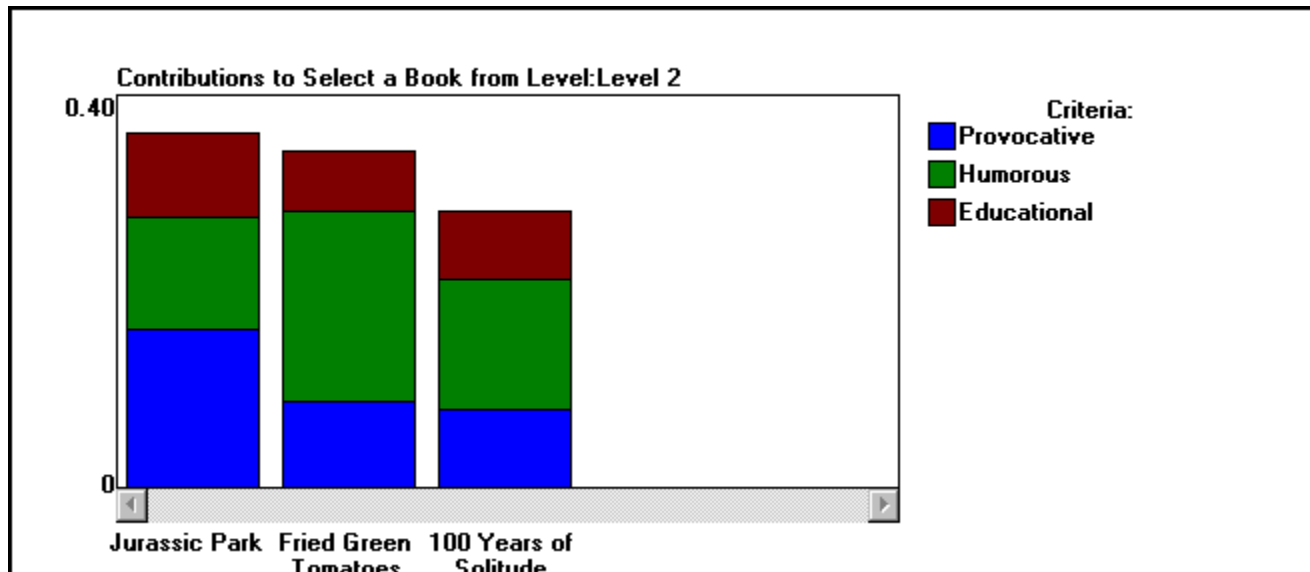
- Alternatives in matrix have survived the evaluation step of the planning process
 - Only qualified plans are considered in final array
- Eliminate any criterion that does not vary from one alternative to the next
- Eliminate alternatives that are dominated by one or more other alternatives



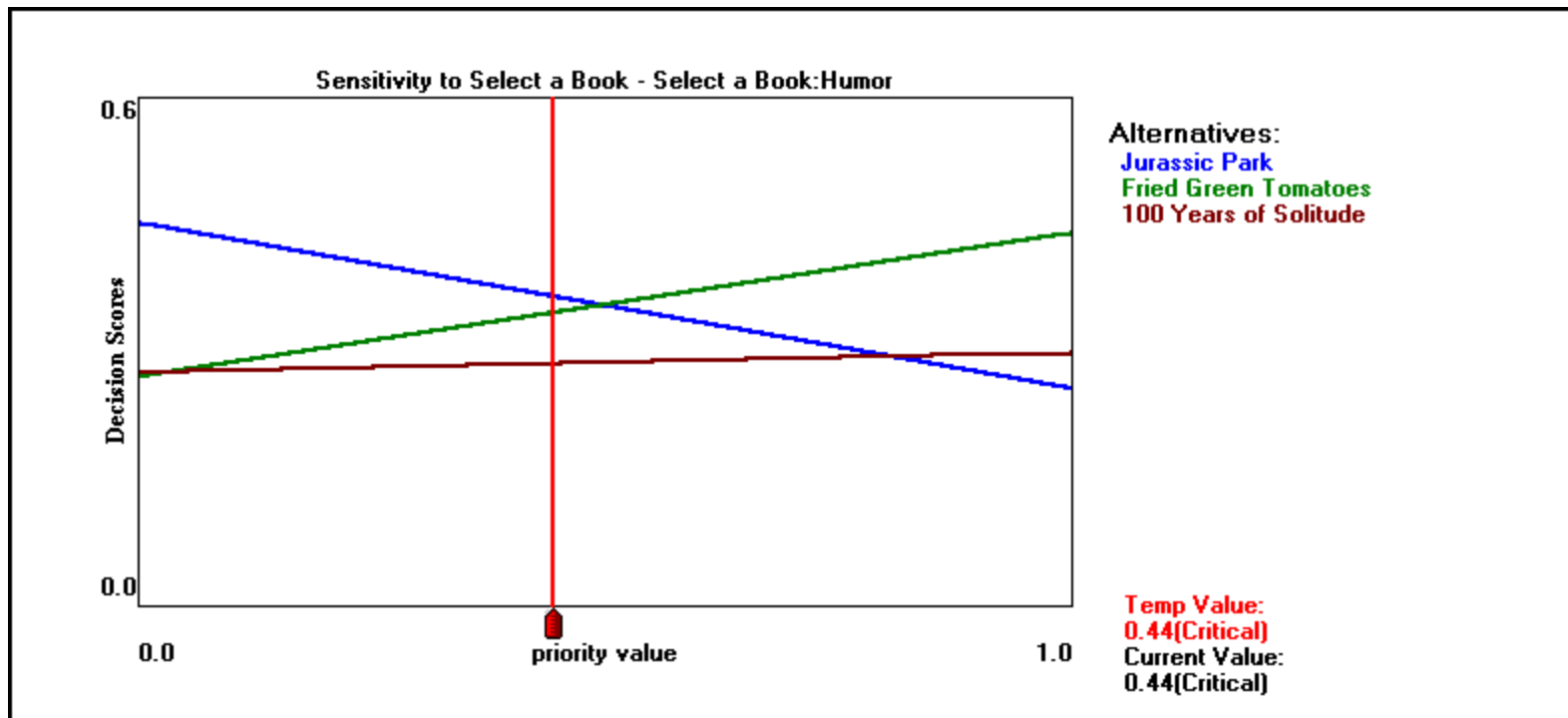
Simple Rules

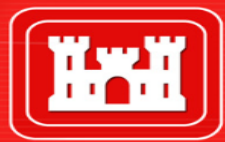
- Optimization—net benefits
- Domination Procedures—better/worse at everything
- Conjunctive Procedures—meets all criteria thresholds
- Disjunctive Procedures—meets at least one criterion threshold

DecisionPlus - Display of Contributions By Criteria



DecisionPlus - Sensitivity to Weights





For More Information

- IWR report, *Trade-Off Analysis Planning and Procedures Guidebook*, published on the IWR web site.

Trade-Off Links to Reformulation

- Conflicts are identified but not always resolved
 - Understanding win/lose tradeoffs may provide opportunities to refine planning objectives and opportunities for reformulation
- Trade-offs are illuminated but not universally supported
 - Understanding differing values may lead to reconsideration of planning objectives and new opportunities for reformulation

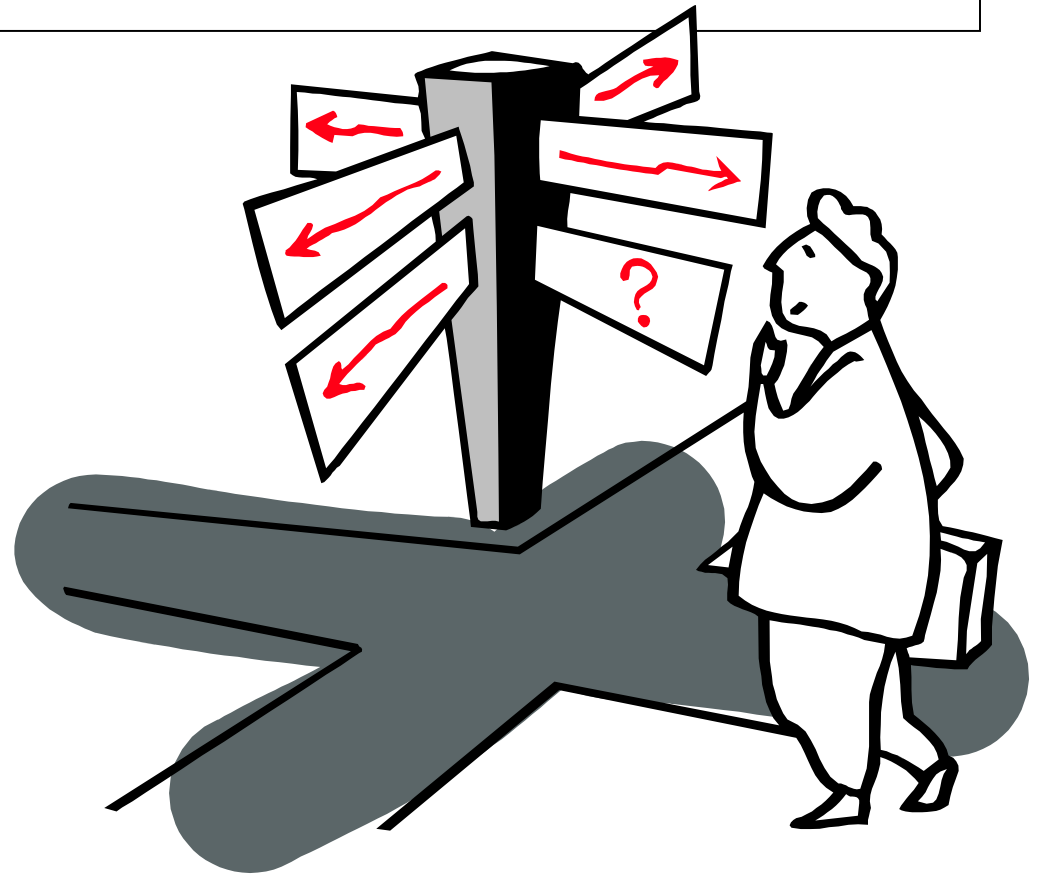
Decision Making

- Time to make a decision
- MCDM framework offers better decisions not perfect ones
- Decisions remain difficult with or without multicriteria analysis.

Inform Decision Makers of Choices

Present Information

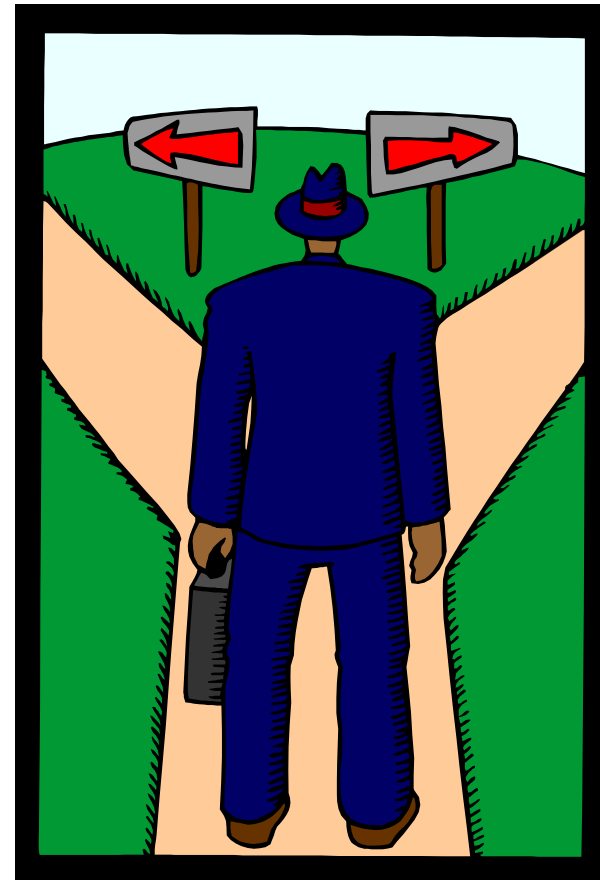
- Be Clear
- Be Concise
- Be Accurate



Select a Plan

Who: Non-Federal sponsor and the Corps

- **With input from:**
 - **Other Federal agencies**
 - **Public**
 - **Non-Federal agencies**
 - **NGOs**
 - **Other Stakeholders**
- **Then: Finalize Report**



Take Away Points

- Trade offs occur when you cannot efficiently have more of one purpose without giving up some of another purpose
- Comparing Plans involving non-monetary outputs involves value judgments
- Study teams have flexibility in applying trade-off strategies to balance value judgments, valid analytics, and project efficiency
- Some seemingly intuitive methods for addressing trade-offs are flawed and may be harmful to the selection process